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ALBERTA

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***January 1994***



***Chemistry 30***  
***Grade 12 Diploma Examination***

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*January 1994*  
**Chemistry 30**  
*Grade 12 Diploma Examination*

**Description**

Time allotted: 2.5 h. You may take an additional 0.5 h to complete the examination if needed.

Total possible marks: 70

This is a **closed-book** examination consisting of **three** parts:

**Part A**

has 42 multiple-choice questions each with a value of one mark.

**Part B**

has 7 numerical-response questions each with a value of one mark.

**Part C**

has 3 written-response questions for a total of 21 marks.

A chemistry data booklet is provided for your reference.

**Instructions**

- Fill in the information required on the answer sheet and the examination booklet as directed by the presiding examiner.
- You are expected to provide your own scientific calculator.
- Carefully read the instructions for each part before proceeding.
- The presiding examiner will collect your answer sheet and examination booklet and send them to Alberta Education.
- Do not fold the answer sheet.

**Note:** *The perforated pages at the back of this booklet may be torn out and used for your rough work. No marks will be given for work done on the tear-out pages.*

Instructions

Time Allowed: 2.5 hours (150 minutes)  
Examiners: 2 (one invigilator and one scribe)  
Examination: 120 minutes

Total possible marks: 100

This is a closed-book examination.  
No materials are permitted.

Part A

Part A consists of 10 multiple-choice questions worth  
10 marks (10% of the total).

Part B

Part B consists of 10 short-answer questions worth  
10 marks (10% of the total).

Part C

Part C consists of 10 long-answer questions worth  
80 marks (80% of the total).

A student's total score is determined by  
adding the marks for all three parts.

Instructions

This is a closed-book examination.  
No materials are permitted.  
Examiners: 2 (one invigilator and one scribe)  
Examination: 120 minutes

Total possible marks: 100

This is a closed-book examination.  
No materials are permitted.

The following questions are worth  
10 marks (10% of the total).

Part B

The following questions are worth  
10 marks (10% of the total).

Part C

The following questions are worth  
80 marks (80% of the total).

A student's total score is determined by  
adding the marks for all three parts.

# **Part A: Multiple Choice**

(42 Questions)

## **Instructions**

- Consider all numbers used in the questions to be the result of a measurement.
- Read each question carefully and decide which of the choices **best** completes the statement or answers the question.
- Locate that question number on the separate answer sheet provided and fill in the circle that corresponds to your choice.

## **Example**

This diploma examination is for the subject of

- A. biology
- B. physics
- C. chemistry
- D. mathematics

Answer Sheet

(A) (B) ● (D)

- Use an HB pencil only.
- If you wish to change an answer, erase **all** traces of your first answer.

**Note:** The perforated pages at the back of this booklet may be torn out and used for your rough work. **No marks** will be given for work done on the tear-out pages.

**Do not turn the page to start the examination until told to do so by the presiding examiner.**

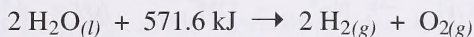


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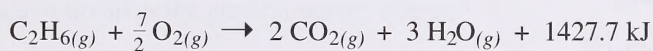
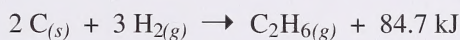
1. The metal that requires the most energy to raise 1.00 g of it 1.00°C is
- A. aluminum
  - B. copper
  - C. nickel
  - D. lead

*Use the following information to answer question 2.*



2. If one mole of water is decomposed, the  $\Delta H$  is
- A. -571.6 kJ
  - B. +571.6 kJ
  - C. +285.8 kJ
  - D. -285.8 kJ
- 

*Use the following information to answer question 3.*



3. The molar heat of combustion of ethane is
- A. +84.7 kJ/mol
  - B. -84.7 kJ/mol
  - C. +1427.7 kJ/mol
  - D. -1427.7 kJ/mol
-

4. The melting of ice is
- A. an endothermic process
  - B. a chemical process
  - C. a redox process
  - D. a nuclear process

*Use the following information to answer question 5.*



5. One can correctly conclude that
- A. sodium ions and hydroxide ions have more energy than  $\text{NaOH}_{(s)}$
  - B. the crystallization of sodium hydroxide is an exothermic process
  - C. the temperature of the water would rise as the solid dissolves
  - D. solid sodium hydroxide has less energy than aqueous sodium hydroxide
- 
6. A major industrial problem is the corrosion of metals into their oxides. Which metallic oxide requires the greatest amount of energy, per mole, to be refined back into the pure metal?
- A.  $\text{CuO}_{(s)}$
  - B.  $\text{PbO}_{2(s)}$
  - C.  $\text{Fe}_2\text{O}_{3(s)}$
  - D.  $\text{Al}_2\text{O}_{3(s)}$



Use the following information to answer question 7.

A commercial cold-pack consists of an outer pouch containing  $\text{NH}_4\text{NO}_3(s)$  and an inner pouch containing water. When the contents of the pouches are mixed, a cooling effect is observed.

$$\Delta H^\circ_f \text{ for } \text{NH}_4\text{NO}_3(s) = -365.6 \text{ kJ/mol}$$

$$\Delta H^\circ_f \text{ for } \text{NH}_4\text{NO}_3(aq) = -339.4 \text{ kJ/mol}$$

7. When the cold-pack is activated, the observed cooling effect suggests that the energy of the pack
- A. increases and the energy of the surroundings decreases
  - B. decreases and the energy of the surroundings increases
  - C. increases and the energy of the surroundings increases
  - D. decreases and the energy of the surroundings decreases
- 
8. A phase change of a substance results in a change primarily in the substance's
- A. mass
  - B. potential energy
  - C. kinetic energy
  - D. type of chemical bonding
9. Which reaction involves the greatest energy change?
- A.  $^1_1\text{H} + ^3_1\text{H} \rightarrow ^4_2\text{He}$
  - B.  $\text{C}_{12}\text{H}_{22}\text{O}_{11(s)} + 12 \text{O}_{2(g)} \rightarrow 12 \text{CO}_{2(g)} + 11 \text{H}_2\text{O}_{(g)}$
  - C.  $\text{H}_{2(g)} + \text{O}_{2(g)} \rightarrow \text{H}_2\text{O}_{2(l)}$
  - D.  $\text{H}_2\text{O}_{(s)} \rightarrow \text{H}_2\text{O}_{(g)}$

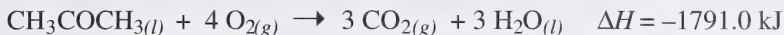
10. A 225.0 g sample of a liquid hydrocarbon requires the addition of 9.54 kJ of heat to increase its temperature from 20.5°C to 45.0°C. What is the specific heat capacity of this hydrocarbon?
- A. 17.3 J/g•°C  
B. 1.18 J/g•°C  
C. 1.73 J/g•°C  
D. 1.88 J/g•°C
11. The combustion of a 5.00 g sample of cellulose in a bomb calorimeter causes 2.35 kg of water to increase in temperature from 20.4°C to 24.5°C. What is the heat produced by this reaction?
- A. 85.9 J  
B. 8.07 kJ  
C. 19.4 kJ  
D. 40.4 kJ

*Use the following information to answer question 12.*

The molar heat of combustion for ethylene glycol,  $\text{C}_2\text{H}_4(\text{OH})_{2(l)}$ , is  $-1181.2 \text{ kJ/mol}$  when the products of combustion are gases.

12. The heat of formation of ethylene glycol is
- A.  $+590.6 \text{ kJ/mol}$   
B.  $-331.2 \text{ kJ/mol}$   
C.  $-500.7 \text{ kJ/mol}$   
D.  $-1181.2 \text{ kJ/mol}$
-

Use the following information to answer question 13.



13. The energy change when 1.00 g of  $\text{CH}_3\text{COCH}_3(l)$  reacts is
- A. 30.8 kJ which is released to the surroundings
  - B. 30.8 kJ which is absorbed by the reaction
  - C. 1791.0 kJ which is released to the surroundings
  - D. 1791.0 kJ which is absorbed by the reaction
- 
14. A student gathered the following information about a cafeteria beverage:
- It tastes sour.
  - Turns blue litmus red.
  - Conducts an electric current.
  - Reacts with  $\text{Zn}_{(s)}$  to produce a gas.
- The beverage is
- A. acidic
  - B. basic
  - C. soapy
  - D. an alcohol
15. Which reaction would result in a solution with a pH of 7 when an equivalent number of moles of each reagent is used?
- A.  $\text{H}_2\text{SO}_{4(aq)} + \text{NH}_{3(aq)}$
  - B.  $\text{HBr}_{(aq)} + \text{NaOH}_{(aq)}$
  - C.  $\text{CH}_3\text{COOH}_{(aq)} + \text{KOH}_{(aq)}$
  - D.  $\text{Na}_{(s)} + \text{H}_2\text{O}_{(l)}$



16. An example of a neutralization reaction is
- A.  $\text{H}_3\text{O}^+_{(aq)} + \text{NH}_{3(g)} \rightarrow \text{NH}_4^+_{(aq)} + \text{H}_2\text{O}_{(l)}$
  - B.  $2 \text{H}_{2(g)} + \text{O}_{2(g)} \rightarrow 2 \text{H}_2\text{O}_{(l)}$
  - C.  $\text{CH}_{4(g)} + 2 \text{O}_{2(g)} \rightarrow \text{CO}_{2(g)} + 2 \text{H}_2\text{O}_{(g)}$
  - D.  $2 \text{H}_2\text{O}_{(l)} \rightarrow 2 \text{H}_{2(g)} + \text{O}_{2(g)}$
17. According to the Brønsted-Lowry theory, the species that is most likely to act as either an acid or a base is
- A.  $\text{HNO}_{2(aq)}$
  - B.  $\text{Mo}^-_{(aq)}$
  - C.  $\text{HOOC}^-\text{COO}^-_{(aq)}$
  - D.  $\text{NH}_4^+_{(aq)}$
18. The ion  $\text{H}_2\text{AsO}_4^-_{(aq)}$  has both a conjugate acid and a conjugate base. These are, respectively,
- A.  $\text{H}_3\text{AsO}_{4(aq)}$ ,  $\text{AsO}_4^{3-}_{(aq)}$
  - B.  $\text{HAsO}_4^{2-}_{(aq)}$ ,  $\text{AsO}_4^{3-}_{(aq)}$
  - C.  $\text{H}_3\text{AsO}_{4(aq)}$ ,  $\text{HAsO}_4^{2-}_{(aq)}$
  - D.  $\text{H}_4\text{AsO}_4^+_{(aq)}$ ,  $\text{AsO}_4^{3-}_{(aq)}$
19. Which statement is **true** for a solution with a pH of 7.8?
- A. The solution turns litmus paper red.
  - B.  $[\text{OH}^-_{(aq)}] > [\text{H}_3\text{O}^+_{(aq)}]$
  - C. The solution will not conduct an electric current.
  - D. The addition of bromothymol blue results in a yellow solution.

20. The pH of a  $4.0 \times 10^{-2}$  mol/L monoprotic acid solution was measured and found to be 2.10. For this acid, the per cent dissociation with water is
- A. 0.79%
  - B. 4.0%
  - C. 20%
  - D. 80%
21. Which of these substances is the weakest base?
- A.  $\text{Na}_5\text{IO}_6(\text{aq})$
  - B.  $\text{Na}_4\text{HIO}_6(\text{aq})$
  - C.  $\text{Na}_3\text{H}_2\text{IO}_6(\text{aq})$
  - D.  $\text{Na}_2\text{H}_3\text{IO}_6(\text{aq})$
22. A student tested an unidentified solution. The observation that would **not** help the student prove that the unidentified solution is basic is that its color is
- A. yellow in methyl orange
  - B. red in phenol red
  - C. pink in phenolphthalein
  - D. blue in bromothymol blue
23. The pH at the equivalence point of an acid-base titration is 3.8. This result would be consistent with the titration of a
- A. strong acid with a strong base
  - B. weak acid with a strong base
  - C. strong acid with a weak base
  - D. weak acid with a weak base

24. In which acid-base reaction would the reactants be favored?

- A.  $\text{HCO}_3^-{}_{(aq)} + \text{HNO}_{2(aq)} \rightleftharpoons \text{H}_2\text{CO}_{3(aq)} + \text{NO}_2^-{}_{(aq)}$   
B.  $\text{HCO}_3^-{}_{(aq)} + \text{S}^{2-}{}_{(aq)} \rightleftharpoons \text{CO}_3^{2-}{}_{(aq)} + \text{HS}^-{}_{(aq)}$   
C.  $\text{HCO}_3^-{}_{(aq)} + \text{HCOOH}_{(aq)} \rightleftharpoons \text{H}_2\text{CO}_{3(aq)} + \text{HCOO}^-{}_{(aq)}$   
D.  $\text{HCO}_3^-{}_{(aq)} + \text{HS}^-{}_{(aq)} \rightleftharpoons \text{CO}_3^{2-}{}_{(aq)} + \text{H}_2\text{S}_{(aq)}$

25. If the concentration of  $\text{OH}^-{}_{(aq)}$  in a solution is  $1.0 \times 10^{-9}$  mol/L, then the  $[\text{H}_3\text{O}^+{}_{(aq)}]$  must be

- A.  $1.0 \times 10^{-23}$  mol/L  
B.  $1.0 \times 10^{-14}$  mol/L  
C.  $1.0 \times 10^{-5}$  mol/L  
D.  $1.0 \times 10^5$  mol/L

Use the following information to answer question 26.

These titration data were obtained for a  $\text{HCl}_{(aq)}$  sample titrated with 0.10 mol/L  $\text{NaOH}_{(aq)}$ .

Trial	I	II	III	IV
volume of acid pipetted (mL)	10.0	10.0	10.0	10.0
final buret reading (mL)	13.3	25.9	38.5	33.3
initial buret reading (mL)	1.2	13.2	25.9	20.6
volume of $\text{NaOH}_{(aq)}$ used (mL)	12.1	12.7	12.6	12.7

Note: the indicator used in all cases was phenolphthalein

26. Which statement explains the low volume of  $\text{NaOH}_{(aq)}$  used in trial I?

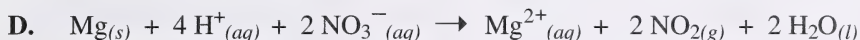
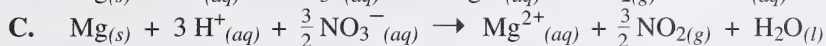
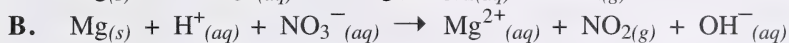
- A. The color observed was dark pink.  
B. The buret tip was not filled before titrating.  
C. The  $\text{HCl}_{(aq)}$  was diluted by water left in the pipet.  
D. The  $\text{NaOH}_{(aq)}$  was diluted by water left in the buret.



27. When methyl orange is added to a solution, the solution turns yellow. The pH of the solution is probably
- A. between 0 and 3.2
  - B. between 3.2 and 4.4
  - C. equal to 3.5
  - D. greater than 4.4
28. When an aqueous solution of baking soda,  $\text{NaHCO}_3(aq)$ , is used to clean up the deposits around the battery posts in a car battery, a vigorous reaction results and a gas is given off. The “lime water” test identifies the gas as carbon dioxide. A correct explanation of this reaction is that the
- A. baking soda reacted with the lead post and produced hydrogen and carbon dioxide
  - B. aqueous solution of baking soda contained a large amount of dissolved carbon dioxide that was driven off by the heat generated in the reaction
  - C. corrosion contained some hydrocarbon materials that were burned by the reaction, thus producing carbon dioxide
  - D. carbonic acid produced when the hydrogen carbonate ion reacted with sulphuric acid immediately broke down into water and carbon dioxide
29. When excess copper is added to concentrated nitric acid, the resulting solution
- A. is basic
  - B. is greenish blue and warmer
  - C. cannot react with tin
  - D. has a lower pH

30. If a neutral atom becomes positively charged, then it has
- A. been reduced
  - B. been oxidized
  - C. lost a proton
  - D. gained a neutron
31. In the reaction  $2 \text{Ag}^+_{(aq)} + \text{Cd}_{(s)} \rightarrow \text{Cd}^{2+}_{(aq)} + 2 \text{Ag}_{(s)}$ , the strongest oxidizing agent is
- A.  $\text{Ag}^+_{(aq)}$
  - B.  $\text{Cd}_{(s)}$
  - C.  $\text{Cd}^{2+}_{(aq)}$
  - D.  $\text{Ag}_{(s)}$
32. Metal  $\text{Q}_{(s)}$  loses 5 electrons per atom when it reacts with nonmetal  $\text{R}_{(g)}$ . Each atom of  $\text{R}_{(g)}$  gains 3 electrons. The balanced chemical equation for this reaction is
- A.  $\text{Q}_{(s)} + \text{R}_{(g)} \rightarrow \text{QR}_{(s)}$
  - B.  $5 \text{Q}_{(s)} + 2 \text{R}_{(g)} \rightarrow \text{Q}_5\text{R}_{2(s)}$
  - C.  $5 \text{Q}_{(s)} + 3 \text{R}_{(g)} \rightarrow \text{Q}_5\text{R}_{3(s)}$
  - D.  $3 \text{Q}_{(s)} + 5 \text{R}_{(g)} \rightarrow \text{Q}_3\text{R}_{5(s)}$
33. In which substance does sulphur have an oxidation state of zero?
- A.  $\text{SO}_{3(g)}$
  - B.  $\text{S}_{8(s)}$
  - C.  $\text{H}_2\text{SO}_{4(aq)}$
  - D.  $\text{Na}_2\text{SO}_{3(s)}$

34. A piece of magnesium metal reacts when it is placed into nitric acid. The balanced redox reaction is



35. A student constructed an electrochemical cell using an electrode of aluminum in aqueous aluminum chloride solution and an electrode of nickel in aqueous nickel(II) chloride solution. Assuming standard conditions, the net potential of this cell should be

A.  $-1.92 \text{ V}$

B.  $-1.40 \text{ V}$

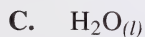
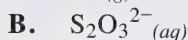
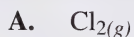
C.  $+1.40 \text{ V}$

D.  $+1.92 \text{ V}$

36. Chlorine gas has an irritating odor and can cause lung damage. To prevent chlorine from escaping into the air, it can be bubbled through  $\text{Na}_2\text{S}_2\text{O}_3$ . The reaction that occurs is



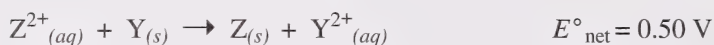
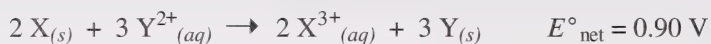
The oxidizing agent in this reaction is





37. A researcher wants to test aluminum, zinc, chromium, and copper individually for their suitability as a dental filling. Keeping in mind many foods are acidic, which metal would be most suitable to investigate as a filling?
- A. aluminum  
B. zinc  
C. chromium  
D. copper

*Use the following information to answer question 38.*

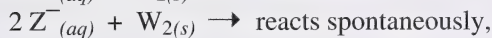
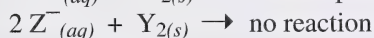
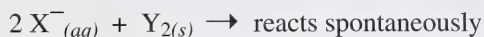


38. If metal  $\text{X}_{(s)}$  is aluminum, then metal  $\text{Z}_{(s)}$  is

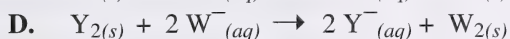
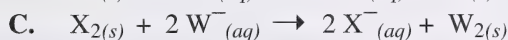
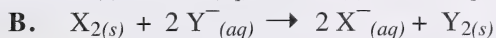
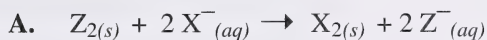
- A.  $\text{Zn}_{(s)}$   
B.  $\text{Ni}_{(s)}$   
C.  $\text{Cr}_{(s)}$   
D.  $\text{Fe}_{(s)}$
- 

39. In an analysis to determine the concentration of  $\text{Sn}^{2+}_{(aq)}$  ions in a tin ore solution, a 25.0 mL sample of the solution is acidified and titrated to a pink endpoint with 40.0 mL of 0.200 mol/L  $\text{KMnO}_{4(aq)}$ . The concentration of  $\text{Sn}^{2+}_{(aq)}$  ions in the sample is
- A. 1.25 mol/L  
B. 0.800 mol/L  
C. 0.128 mol/L  
D. 0.100 mol/L

**40.** Given the hypothetical reactions



another spontaneous reaction would be



**41.** A spoon is electroplated with silver. This is an example of

**A.** a spontaneous electrochemical process in which chemical energy is converted to electrical energy

**B.** an electrolytic process in which chemical energy is converted to electrical energy

**C.** a spontaneous electrochemical process in which electrical energy is converted to chemical energy

**D.** an electrolytic process in which electrical energy is converted to chemical energy

42. In an electrochemical cell, the cathode is defined as the
- A. electrolyte to which cations migrate
  - B. electrolyte to which anions migrate
  - C. electrode at which oxidation occurs
  - D. electrode at which reduction occurs

***You have now completed Part A. Proceed directly to Part B.***

## Part B: Numerical Response (7 Questions)

### Instructions

- Consider all numbers used in the questions to be the result of a measurement.
- Read each question carefully.
- Record your answer on the answer sheet provided by writing it in the boxes and then filling in the corresponding circles.
- Enter the first digit of your answer in the left-hand box and leave any unused boxes blank.**
- Use an HB pencil only.
- If you wish to change an answer, erase **all** traces of your first answer.

### Sample Calculation Question and Solution

The mass in kilograms of silver produced when 2.20 mol of silver nitrate reacts with excess copper is \_\_\_\_\_ kg.  
(Record your answer to three digits.)

$$\begin{aligned}\text{mass}_{\text{Ag}} &= 0.220 \text{ mol} \times 107.87 \text{ g/mol} \\ &= 23.7314 \text{ g} \\ &= 0.24 \text{ kg (recorded to three digits)}\end{aligned}$$

Record 0.24 on the answer sheet →

0	.	2	4
•	•	•	•
0	0	0	0
1	1	1	1
2	2	•	2
3	3	3	3
4	4	4	•
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

### Sample Correct-order Question and Solution

When the following subjects are arranged in alphabetical order, the order is \_\_\_\_\_.  
(Record all four digits.)

- mathematics
- chemistry
- biology
- physics

Answer 3, 2, 1, 4

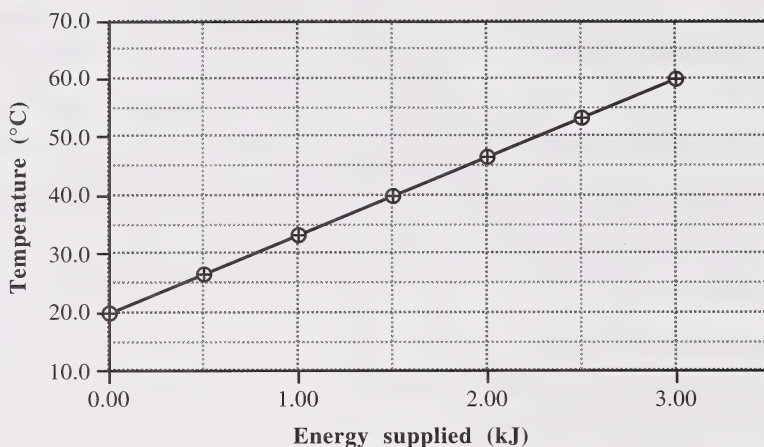
Record 3214 on the answer sheet →

3	2	1	4
•	•	•	•
0	0	0	0
1	1	•	1
2	•	2	2
•	3	3	3
4	4	4	•
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

**Start Part B immediately.**

Use the following information to answer question 1.

A 60.0 g sample of an unidentified sample was heated and the following data was collected.



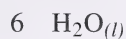
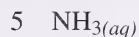
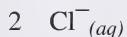
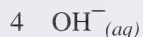
1. The specific heat of the unidentified sample is \_\_\_\_\_ J/g°C.  
(Record your answer to three digits.)

2. A student calculates the molar heat of combustion for octane to be  $-4963$  kJ/mol. The theoretical molar heat of combustion for octane is  $-5074.2$  kJ/mol. The per cent error in the student's result is \_\_\_\_\_%.  
(Record your answer to three digits.)

RECORD YOUR ANSWER ON THE ANSWER SHEET



Use the following information to answer question 3.



3. Solutions of ammonium chloride and sodium hydroxide are mixed together. The net ionic equation that represents the acid-base reaction that occurs is outlined below. The reactants and products in the order stated, as selected from the above numbered species, would be



RECORD YOUR ANSWERS

4. The pH of a 0.10 mol/L solution of  $\text{HCOOH}_{(aq)}$  is \_\_\_\_\_.  
(Record your answer to three digits.)

RECORD YOUR ANSWERS

5. A 50.0 mL sample of a strong acid has a pH of 1.85. What volume of water, in millilitres, should be added to this acid to raise the pH to 2.30?  
(Record your answer to three digits.)

DO NOT WRITE IN THESE SPACES

6. The oxidation number of chlorine in each of the ions  $\text{ClO}_4^-$ ,  $\text{ClO}_3^-$ ,  $\text{ClO}_2^-$ ,  $\text{ClO}^-$ , is respectively \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_.

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7. An electrochemical cell,  $\text{Zn}_{(s)} / \text{Zn}^{2+}_{(aq)} // \text{Ag}^{+}_{(aq)} / \text{Ag}_{(s)}$ , is constructed using zinc and silver electrodes. If the anode mass changes by 6.54 g, then the predicted mass change for the cathode is \_\_\_\_\_ g.  
(Record your answer to three digits.)

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***You have now completed Part B. Proceed directly to Part C.***

## **Part C: Written Response** (3 Questions)

### **Instructions**

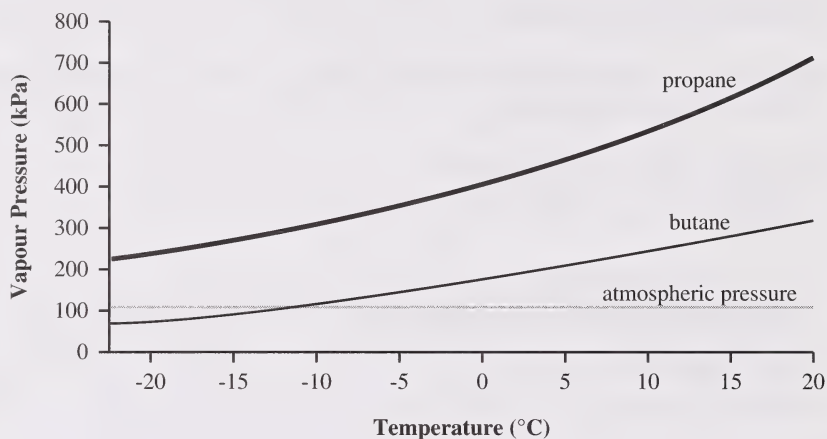
- Consider all numbers used in the questions to be the result of a measurement.
- Read each question carefully.
- Write your answers in the examination booklet as neatly as possible.
- For full marks, your answers **must show all** pertinent explanations, calculations, and formulas.
- Your answers **should be** presented in a well-organized manner using complete sentences for a written response, and correct units and significant digits for a numerical response.

**Note:** The perforated pages at the back of this booklet may be torn out and used for your rough work. **No marks** will be given for work done on the tear-out pages.

**Start Part C immediately.**

Use the following information to answer question 1.

Most camping stoves contain fuel in a tank, and the designer of the stove must find a way to move the fuel, a little at a time, to the burner. For propane and butane stoves, this is easy because the fuel is stored under pressure greater than atmospheric pressure and comes out on its own as soon as the valve is opened. (Heat of combustion of propane = 46.3 kJ/g)



1. a. Camp stoves often use compressed butane gas as a fuel. Determine the heat of combustion of butane in **kJ/g**. ( $\text{H}_2\text{O}_{(g)}$  is one of the products.)

(continued on page 21)

- b. Which of the two fuels would you recommend for a **winter** camping trip? Give two valid reasons to justify your answer. (Consider energy yield and operation in cold weather in your explanation.)



2. The pain-killing ingredient in an aspirin tablet is acetylsalicylic acid, a weak solid monoprotic acid whose molar mass is 180.16 g/mol. A 1.85 g aspirin tablet is dissolved in water to form 30.0 mL of solution. It is then titrated with 41.9 mL of 0.19 mol/L  $\text{NaOH}_{(aq)}$  to reach the equivalence point.
  - a. Using the abbreviation HASA for acetylsalicylic acid, write the net ionic equation for the reaction between the acid and the base and calculate the mass of acetylsalicylic acid in the tablet. (Assume the reaction is quantitative.)
  - b. Calculate the per cent of acetylsalicylic acid in the tablet.
  - c. Suggest a reason why the tablet is not pure acetylsalicylic acid and outline the properties that you would expect the “filler” to have.

3. Contrast and compare, where possible, electrochemical (voltaic) and electrolytic cells. In your response, explain the changes involved, the design of the cells, and the practical uses of these cells.

***You have now completed the examination.  
If you have time, you may wish to check your answers.***



*No marks will be given for work done on this page.*

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*No marks will be given for work done on this page.*

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